In [278]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from math import sqrt
from sklearn.cluster import KMeans
from sklearn.preprocessing import MinMaxScaler
%matplotlib inline
```

In [279]:
```
df = pd.read_csv('data1.csv')
df
```

Out[279]:

	x	y
0	1.0	1.0
1	1.0	0.9
2	0.9	1.0
3	1.0	-1.0
4	0.9	-1.0
5	1.0	-0.9
6	-1.0	1.0
7	-0.9	1.0
8	-1.0	0.9
9	-1.0	-1.0
10	-0.9	-1.0
11	-1.0	-0.9
12	0.1	0.1

In [280]:
```
km = KMeans(n_clusters=4)
y_predicted = km.fit_predict(df[['x','y']])
y_predicted
```

Out[280]:
```
array([1, 1, 1, 0, 0, 0, 2, 2, 2, 3, 3, 3, 1])
```

In [281]:
```
df['cluster']=y_predicted
df
```

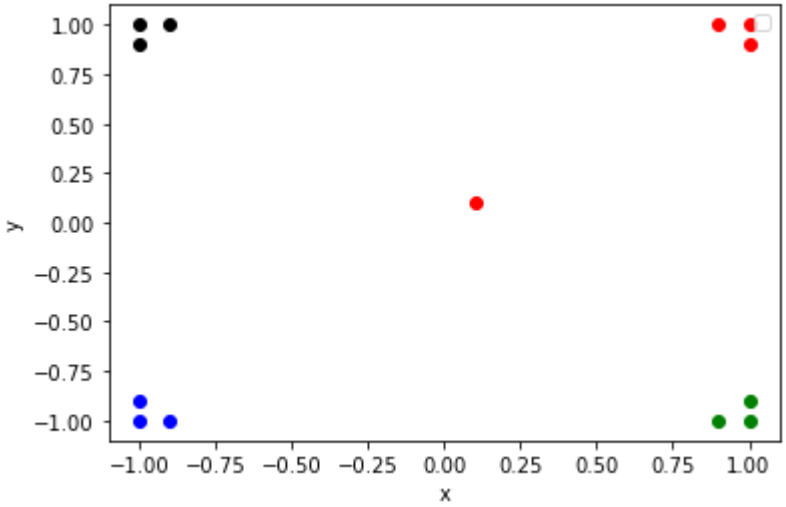
Out[281]:

	x	y	cluster
0	1.0	1.0	1
1	1.0	0.9	1
2	0.9	1.0	1
3	1.0	-1.0	0
4	0.9	-1.0	0
5	1.0	-0.9	0
6	-1.0	1.0	2
7	-0.9	1.0	2
8	-1.0	0.9	2
9	-1.0	-1.0	3
10	-0.9	-1.0	3
11	-1.0	-0.9	3
12	0.1	0.1	1

In [282]:
```
df1 = df[df.cluster==0]
df2 = df[df.cluster==1]
df3 = df[df.cluster==2]
df4 = df[df.cluster==3]
plt.scatter(df1.x,df1.y,color='green')
plt.scatter(df2.x,df2.y,color='red')
plt.scatter(df3.x,df3.y,color='black')
plt.scatter(df4.x,df4.y,color='blue')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
```

```
No handles with labels found to put in legend.
```

Out[282]:
```
<matplotlib.legend.Legend at 0x2c0f0887dc0>
```



In [283]:
```
dist = pd.DataFrame()

dist1=np.zeros(13)
dist2=np.zeros(13)
dist3=np.zeros(13)
dist4=np.zeros(13)

for i in range(0,13):
    dist1[i] = sqrt((df['x'][0]-df['x'][i])**2 + (df['y'][0]-df['y'][i])**2)
    print(dist1)
print("\n")
for i in range(0,13):
    dist2[i] = sqrt((df['x'][3]-df['x'][i])**2 + (df['y'][3]-df['y'][i])**2)
    print(dist2)
print("\n")
for i in range(0,13):
    dist3[i] = sqrt((df['x'][6]-df['x'][i])**2 + (df['y'][6]-df['y'][i])**2)
    print(dist3)
print("\n")
for i in range(0,13):
    dist4[i] = sqrt((df['x'][9]-df['x'][i])**2 + (df['y'][9]-df['y'][i])**2)
    print(dist4)
print("\n")

dist['c1'] = pd.Series(dist1)
dist['c2'] = pd.Series(dist2)
dist['c3'] = pd.Series(dist3)
dist['c4'] = pd.Series(dist4)
clusters=dist.idxmax(axis=1)
print(dist,"\n", clusters)

clust1=clusters.index[clusters=='c1'].tolist()
clust2=clusters.index[clusters=='c2'].tolist()
clust3=clusters.index[clusters=='c3'].tolist()
clust4=clusters.index[clusters=='c4'].tolist()
print("Cluster 1: ",clust1,"\nCluster 2: ",clust2,"\nCluster 3: ",clust3,"\nClust
```

```
          c1        c2        c3        c4
0   0.000000  2.000000  2.000000  2.828427
1   0.100000  1.900000  2.002498  2.758623
2   0.100000  2.002498  1.900000  2.758623
3   2.000000  0.000000  2.828427  2.000000
4   2.002498  0.100000  2.758623  1.900000
5   1.900000  0.100000  2.758623  2.002498
6   2.000000  2.828427  0.000000  2.000000
7   1.900000  2.758623  0.100000  2.002498
8   2.002498  2.758623  0.100000  1.900000
9   2.828427  2.000000  2.000000  0.000000
10  2.758623  1.900000  2.002498  0.100000
11  2.758623  2.002498  1.900000  0.100000
12  1.272792  1.421267  1.421267  1.555635
 0     c4
1     c4
2     c4
3     c3
4     c3
```

In [284]:
```
clusters
```

Out[284]:
```
0     c4
1     c4
2     c4
3     c3
4     c3
5     c3
6     c2
7     c2
8     c2
9     c1
10    c1
11    c1
12    c4
dtype: object
```

In [285]:
```
coord_clust1 = df.iloc[0:3,].mean(axis=0)
coord_clust2 = df.iloc[3:6,].mean(axis=0)
coord_clust3 = df.iloc[6:9,].mean(axis=0)
coord_clust4 = df.iloc[9:13,].mean(axis=0)
print("New coordinates for cluster 1: \n",coord_clust1)
print("New coordinates for cluster 2: \n",coord_clust2)
print("New coordinates for cluster 3: \n",coord_clust3)
print("New coordinates for cluster 4: \n",coord_clust4)
coord_clust1['x']
```

```
New coordinates for cluster 1:
 x          0.966667
y          0.966667
cluster    1.000000
dtype: float64
New coordinates for cluster 2:
 x          0.966667
y         -0.966667
cluster    0.000000
dtype: float64
New coordinates for cluster 3:
 x         -0.966667
y          0.966667
cluster    2.000000
dtype: float64
New coordinates for cluster 4:
 x         -0.7
y         -0.7
cluster    2.5
dtype: float64
```

Out[285]:
```
0.9666666666666667
```

In [286]:
```
dist = pd.DataFrame()

dist1=np.zeros(13)
dist2=np.zeros(13)
dist3=np.zeros(13)
dist4=np.zeros(13)

coord_clust1['x']=df['x'][0]
coord_clust1['y']=df['y'][0]
coord_clust2['x']=df['x'][3]
coord_clust2['y']=df['y'][3]
coord_clust3['x']=df['x'][6]
coord_clust3['y']=df['y'][6]
coord_clust4['x']=df['x'][9]
coord_clust4['y']=df['y'][9]

for j in range(0,1):
    print("K-means iteration: ", j)
    for i in range(0,13):
        dist1[i] = sqrt((coord_clust1['x']-df['x'][i])**2 + (coord_clust1['y']-df
        print(dist1)
    print("\n")
    for i in range(0,13):
        dist2[i] = sqrt((coord_clust2['x']-df['x'][i])**2 + (coord_clust2['y']-df
        print(dist2)
    print("\n")
    for i in range(0,13):
        dist3[i] = sqrt((coord_clust3['x']-df['x'][i])**2 + (coord_clust1['y']-df
        print(dist3)
    print("\n")
    for i in range(0,13):
        dist4[i] = sqrt((coord_clust4['x']-df['x'][i])**2 + (coord_clust2['y']-df
        print(dist4)
    print("\n")

    dist['c1'] = pd.Series(dist1)
    dist['c2'] = pd.Series(dist2)
    dist['c3'] = pd.Series(dist3)
    dist['c4'] = pd.Series(dist4)
    clusters=dist.idxmax(axis=1)
    print(dist,"\n", clusters)

    clust1=clusters.index[clusters=='c1'].tolist()
    clust2=clusters.index[clusters=='c2'].tolist()
    clust3=clusters.index[clusters=='c3'].tolist()
    clust4=clusters.index[clusters=='c4'].tolist()
    print("Cluster 1: ",clust1,"\nCluster 2: ",clust3,"\nCluster 3: ",clust3,"\nC

    coord_clust1 = df.iloc[clust1,].mean(axis=0)
    coord_clust2 = df.iloc[clust2,].mean(axis=0)
    coord_clust3 = df.iloc[clust3,].mean(axis=0)
    coord_clust4 = df.iloc[clust4,].mean(axis=0)

    print("New coordinates for cluster 1: \n",coord_clust1)
    print("New coordinates for cluster 2: \n",coord_clust2)
    print("New coordinates for cluster 3: \n",coord_clust3)
```

```
    print("New coordinates for cluster 4: \n",coord_clust4)
coord_clust1['x']
```

```
 2.         2.00249844 1.9        0.         0.1        0.1
 0.        ]
[2.82842712 2.75862284 2.75862284 2.         1.9        2.00249844
 2.         2.00249844 1.9        0.         0.1        0.1
 1.55563492]
```

	c1	c2	c3	c4
0	0.000000	2.000000	2.000000	2.828427
1	0.100000	1.900000	2.002498	2.758623
2	0.100000	2.002498	1.900000	2.758623
3	2.000000	0.000000	2.828427	2.000000
4	2.002498	0.100000	2.758623	1.900000
5	1.900000	0.100000	2.758623	2.002498
6	2.000000	2.828427	0.000000	2.000000
7	1.900000	2.758623	0.100000	2.002498
8	2.002498	2.758623	0.100000	1.900000
9	2.828427	2.000000	2.000000	0.000000
10	2.758623	1.900000	2.002498	0.100000
11	2.758623	2.002498	1.900000	0.100000

In [287]:
```
coord_clust1 = df.iloc[0:3,].mean(axis=0)
coord_clust2 = df.iloc[3:6,].mean(axis=0)
coord_clust3 = df.iloc[6:9,].mean(axis=0)
coord_clust4 = df.iloc[9:13,].mean(axis=0)
print("New coordinates for cluster 1: \n",coord_clust1)
print("New coordinates for cluster 2: \n",coord_clust2)
print("New coordinates for cluster 3: \n",coord_clust3)
print("New coordinates for cluster 4: \n",coord_clust4)
coord_clust1['x']
```

```
New coordinates for cluster 1:
 x          0.966667
y          0.966667
cluster    1.000000
dtype: float64
New coordinates for cluster 2:
 x          0.966667
y         -0.966667
cluster    0.000000
dtype: float64
New coordinates for cluster 3:
 x         -0.966667
y          0.966667
cluster    2.000000
dtype: float64
New coordinates for cluster 4:
 x         -0.7
y         -0.7
cluster    2.5
dtype: float64
```

Out[287]:
```
0.9666666666666667
```

In [ ]:
```
```

In [ ]:

In [ ]: